

HI-SEAS LUNAR SIMULATIONS: PLANS AND PROGRESS

M. Musilova^{1,2,3}, B. Foing^{1,4,5}, H. Rogers¹ and M. Thangavelu^{1,6,7,8}

¹International Moonbase Alliance (IMA) & Hawaii Space Exploration Analog and Simulation (HI-SEAS), Hawaii, United States (musilova@moonbasealliance.com); ²Institute of Robotics and Cybernetics, Faculty of Electrical Engineering and Information Technology STU in Bratislava, Slovakia; ³Slovak Organisation for Space Activities (SOSA), Bratislava, Slovakia; ⁴ESA ESTEC, Noordwijk & ILEWG, the Netherlands; ⁵Vrije Universiteit Amsterdam, the Netherlands; ⁶Department of Astronautical Engineering, Viterbi School of Engineering & School of Architecture, University of Southern California, Los Angeles, California; ⁷Adjunct Faculty, International Space University, Strasbourg, France; ⁸Board of Directors, National Space Society

Introduction: The Hawaii Space Exploration Analog and Simulation (HI-SEAS) habitat is a lunar and Martian analog research station located on the active volcano Mauna Loa in Hawaii. Missions that take place at HI-SEAS are open to space agencies, organizations and companies worldwide to take part in, provided their research and technology testing will help contribute to the exploration of the Moon and Mars. The International MoonBase Alliance (IMA) has been organizing regular simulated missions to the Moon and Mars at the HI-SEAS habitat since 2018. Mission crews are supported by a Mission Control Center based on the Big Island of Hawaii as well. The surroundings of the HI-SEAS habitat are covered in lava and they contain very interesting geological features from a planetary science perspective, such as lava tubes. Crews and researchers have been collaborating with scientists at NASA Goddard, for instance, on performing biochemical and geophysical studies on some of the lava tubes. Research at HI-SEAS is thus focused on geological, astrobiological and architectural projects relevant to living and working on the Moon and Mars; as well as technological tests using drones, 3Dprinters and rovers; and performing outreach and educational projects.



HI-SEAS crewmember outside of the habitat operating a rover.

EMMIHS analog missions: A series of Euro-MoonMars IMA HI-SEAS (EMMIHS) missions have been taking place at HI-SEAS since 2019. These missions bring together researchers from the European

Space Agency (ESA), IMA, the International Lunar Exploration Working Group (ILEWG), European Space Research and Technology Centre (ESTEC), VU Amsterdam and many other international organizations. The EMMIHS missions typically last for two weeks each. During this time, the crew is isolated within the HI-SEAS habitat, which they cannot leave without performing EVAs (Extra-Vehicular Activities) in analog spacesuits and with the permission of Mission Control. A remote support team at ESTEC, the Netherlands, provides further support for the crew. The EMMIHS campaigns aim to increase the awareness about the research and technology testing that can be performed in analogue environments, in order to help humans become a multiplanetary species.



HI-SEAS crewmembers performing lava tube research.

Future missions and plans: The research and technological experiments conducted at HI-SEAS are going to be used to help build a high fidelity Moon base simulator in Hawaii, and ultimately to establish an actual base on the Moon, as part of IMA's major goals. Such technology testing will include closed-loop systems, in situ resource utilization, construction of agricultural systems and other sustainable processes at HI-SEAS. Furthermore, future missions at HI-SEAS include more EMMIHS campaigns, collaborative missions with ESA, NASA, University of Hawaii and with companies, such as SIFT and Ketone Technologies.